Virginia Wild Trout Management Plan

2019-2028

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Virginia Department of Game and Inland Fisheries

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Introduction

There are more than 3,500 miles of coldwater streams that contain wild trout populations in Virginia. Wild trout are an indicator of healthy watersheds and contribute to our quality of life. The agency's most recent statewide angler survey (VDGIF 2016) revealed that 16.5% of Virginia anglers (~60,000) fished for wild trout. The Virginia Department of Game and Inland Fisheries (VDGIF) Wild Trout Management Plan is intended to inform staff, partners and citizens about the Department's management of wild trout resources within the Commonwealth.

VDGIF, under the direction of a Governor-appointed Board of Directors, is charged specifically by the General Assembly with management of the state's freshwater fisheries resources. The Code of Virginia expresses many legal mandates for the Board and VDGIF, including management of wildlife species (§29.1-103), public education (§29.1-109), law enforcement (§29.1-109), and regulations (§29.1-501). To help clarify and interpret the role of VDGIF in managing wildlife in Virginia, the Board of Directors has adopted the following agency mission statement: **Conserve** and manage wildlife populations and habitat for the benefit of present and future generations. **Connect** people to Virginia's outdoors through boating, education, fishing, hunting, trapping, wildlife viewing and other wildlife-related activities. **Protect** people and property by promoting safe outdoor experiences and managing human-wildlife conflicts.

VDGIF has the management responsibility for wild trout resources located on national forest lands, state-owned lands, and private property within the Commonwealth. Wild Trout populations located within the Shenandoah National Park are managed by the National Park Service through consultation with VDGIF.

What is the VDGIF Wild Trout Management Plan?

The VDGIF Wild Trout Management Plan is the first comprehensive plan developed for wild trout in Virginia. It summarizes the history of wild trout management by VDGIF and provides a blueprint for future management directions. The plan establishes a framework of what needs to be done for wild trout, how it should be done, and when it should be done through 2028. By clarifying management goals and objectives, the plan will help VDGIF effectively address wild trout management issues. As the basis for guiding wild trout management activities, decisions, and projects, the plan will also serve to inform stakeholders of what VDGIF hopes to accomplish. The plan is a strategic plan that is intended to provide overall direction, goals, and objectives for wild trout management (e.g., to increase public awareness of wild trout). However, it is not an operational plan and, as such, does not describe the details necessary to realize specific objectives (e.g., detailed descriptions of programs designed to increase public awareness of wild trout).

Plan Development

VDGIF Aquatics Staff from Regions II, III, and IV met multiple times to develop the Issues, Goals, Objectives and Strategies outlined in the plan.

A Key Stakeholder Committee with representatives from the George Washington and Jefferson National Forest, Shenandoah National Park, Blue Ridge Parkway, Virginia Department of Conservation and Recreation, and the Virginia Council of Trout Unlimited collaborated with VDGIF fisheries biologists to refine the Wild Trout Management Plan. A draft of the plan was made available to the public for review and comment on the Department's webpage, and all comments were addressed in Appendix II of this document.

Plan Format

The plan includes sections relating to the current status of wild trout resources in Virginia, major threats facing wild trout populations, and current initiatives undertaken by the Department. Lastly, there are eleven issues concerning wild trout management identified in the plan. There are goals listed for each issue, specific objectives designed to attain the goals, and suggested strategies clarifying how each objective might be achieved.

Interim Changes to the Plan

The Plan is designed to provide guidance and priorities to help VDGIF manage Virginia's wild trout resources through 2028. The plan should be a dynamic and flexible tool that remains responsive to changing social, environmental, technical, and administrative conditions. VDGIF can make amendments to the Plan as new science becomes available or as circumstances demand.

Glossary

- *Allopatric* – Occurring in separate, non-overlapping geographic location (isolated); single species or population occurring in one geographic location. When describing trout populations, allopatric is used when only one species of wild trout is present in a stream reach. Distinguished from sympatric (overlapping) or peripatric (adjacent).
- *Hatchery-Reared Trout* – Trout raised from egg to adult in a captive hatchery environment. Synonymous with cultured fish or stocked trout.
- *Indigenous* – Native to a certain region
- *Introduced Species* – Non-native species ; non-indigenous species
- *Native Trout* – Trout that are indigenous to Virginia. Brook Trout are the only native trout to Virginia; therefore, wild Brook Trout is synonymous with native trout.
- *Naturalized Trout* / *Wild Non-Native Trout* – Trout not native to Virginia whose ancestral stock originated from a captive hatchery environment, were introduced into a wild environment and then reproduced to create a self-sustained, naturally reproducing population.
- *Non-Native Aquatic Species* – organisms living in an aquatic environment that are not indigenous to that geographic area. Synonymous with Introduced Species.
- *Non-Native Trout* – Trout species not indigenous to Virginia. Rainbow and Brown Trout are considered non-native trout species to Virginia.

- *Repatriated Trout* – Native trout that are relocated to streams in order to restore a population within their historic range.
- *Riparian* – the area along the banks of a stream or river in the immediate floodplain.
- *Southern Appalachian Brook Trout* – A distinct strain of Brook Trout indigenous to watersheds in southwestern Virginia exhibiting unique genetic characteristics. For purposes of management, populations with greater than 95% genetic purity are considered to belong to this strain.
- *Stocked Trout* – Trout that are hatched and/or reared in captivity and then released into a wild environment.
- *Tailwater* – Reach of stream or river directly downstream of a dam.
- *Triploid / Sterile Trout* – Trout that are manipulated in the hatchery at the egg stage to develop three sets of chromosomes rendering them unable to reproduce under any conditions. Triploids are an example of sterile trout.
- *Wild Trout* – Trout that are hatched and reared in a wild environment through natural reproduction. Wild trout in Virginia include both native and naturally reproducing Brook, Brown, and Rainbow Trout.

Wild Trout Resources (Current Status)

Brook Trout (*Salvelinus fontinalis*)

The Brook Trout is the only salmonid native to Virginia. Actually, it is classified as a char, more closely related to Lake Trout and Bull Trout than Rainbow or Brown Trout. It is also Virginia's state fish. They are native to a wide area of Eastern North America (Appalachian Mountains from Maine to Georgia), Canada from the Hudson Bay basin east, the Great Lakes-Saint Lawrence system, the Canadian maritime provinces, and the upper Mississippi River drainage as far west as eastern Iowa. MacCrimmon and Campbell (1969) suggested the historical range of Brook Trout in Virginia to include northern Virginia and all areas west of the piedmont region (Figure 1). In addition, Jenkins and Burkhead (1993) provided a thorough review of sources documenting the historic distribution of Brook Trout in Virginia. However, they mention, the actual native range of Brook Trout in Virginia is unclear due to extirpation and stocking. Using the suspected historical distribution, the Eastern Brook Trout Joint Venture (EBTJV) reported that Brook Trout were only found in 42% of subwatersheds once occupied in Virginia (EBTJV 2016). In many cases, there is no scientific evidence that Brook Trout once inhabited many of the streams located within the proposed historical range. Anecdotal information, confirming the historical presence of Brook Trout, does not even exist for many streams.

VDGIF has documented declines in occupied habitat on several streams and recognizes threats that may cause additional population declines. Therefore, the Brook Trout was listed as a Species of Greatest Conservation Need in the 2015 Virginia Wildlife Action Plan (VDGIF 2015) http://www.bewildvirginia.org/species/. Wild Brook Trout currently occupy over 614 individual streams (2,000+ miles) in Virginia (Figure 2).

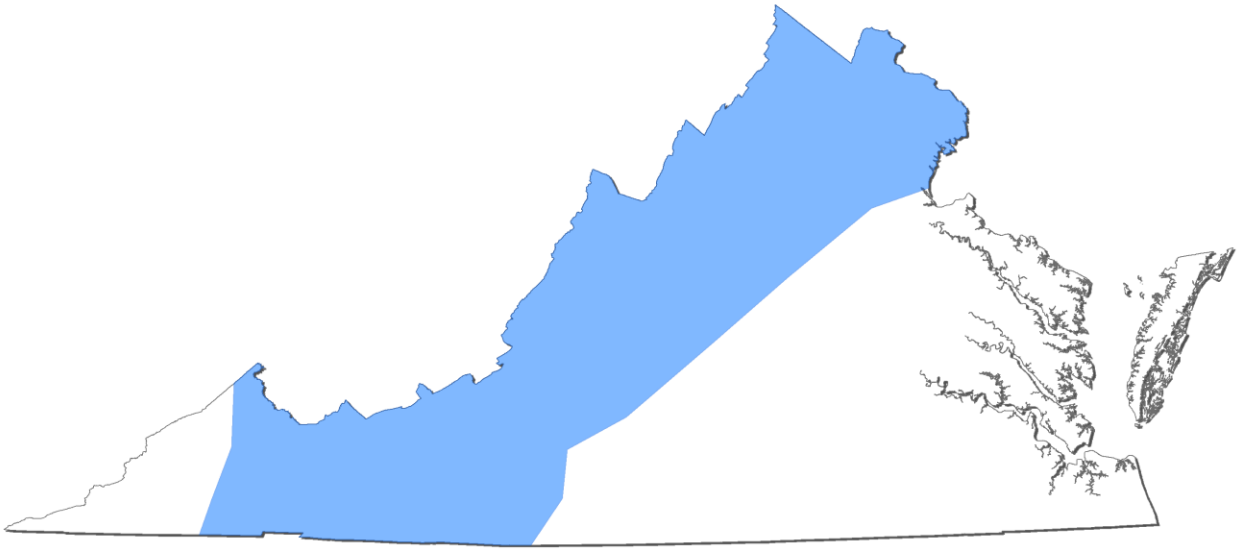

Figure 1. Suggested historic range of Brook Trout in Virginia (MacCrimmon and Campbell 1969).

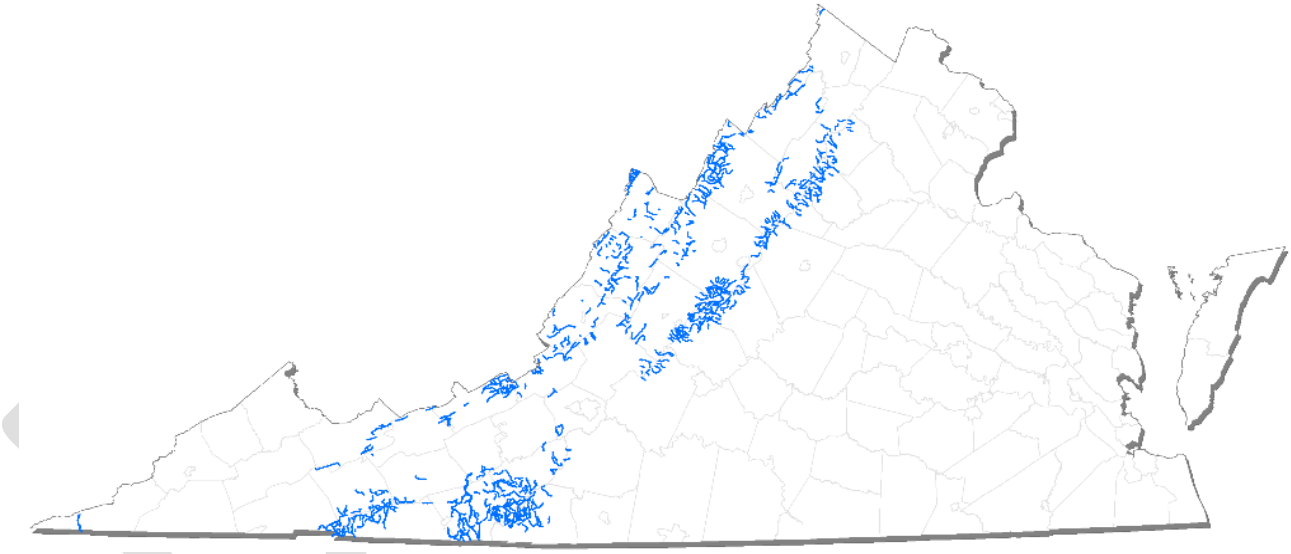

Figure 2. 2018 distribution of wild Brook Trout in the Commonwealth of Virginia.

Brook Trout prefer water temperatures below 65 ˚F and do not tolerate higher water temperatures as well as Rainbow and Brown Trout. They also require exceptional water quality that is well oxygenated. Preferred stream habitat includes sand and gravel bottoms with very little siltation. Pool habitat with woody debris and other forms of cover are also important habitat components. Brook Trout prey on a wide variety of items, with younger fish feeding on small insects and adults feeding on many types of aquatic insects, terrestrial insects, snails, crayfish, worms, and small fishes. Brook Trout Spawn in Virginia during the months of October and November. Adults rarely grow past 12 inches in length and live past age four at Virginia's

latitude. However, in a few productive streams Brook Trout up to 18 inches have been collected by VDGIF biologists.

Hatchery Brook Trout were first stocked in some Virginia waters in the 1870's by the U.S. Fisheries Commission and were stocked out of Montebello State Fish Hatchery as early as the late 1920s. The Department currently stocks hatchery-reared Brook Trout in multiple streams and small impoundments in Western and Southwestern Virginia.

In the 1990s, geneticists determined that there was a division at the subspecies level between southern and northern derived Brook Trout populations, with the zone of contact being roughly at the New River Watershed in Virginia. However, before this was recognized; Brook Trout of northern origin were widely stocked throughout the Southeast. Researchers at Virginia Tech conducted genetic analysis of wild Brook Trout from 56 streams in the New, James, Holston, and Yadkin River drainages in the mid-2000s (Davis and Hallerman 2008). It was determined that pure northern, southern and introgressed (northern/southern) Brook Trout populations existed in these watersheds (Figure 3).

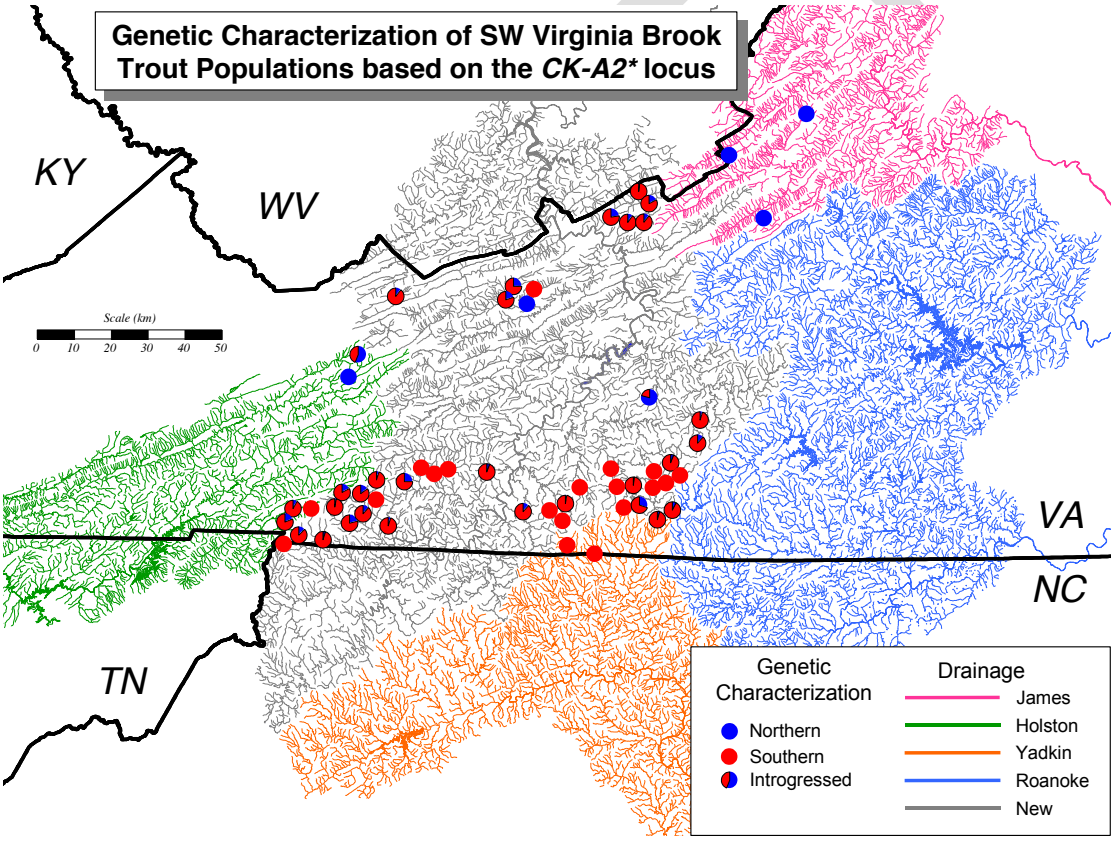

Figure 3. Genetic characterization of select wild Brook Trout populations (Davis and Hallerman 2008).

Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow Trout are native to the Pacific basin, from the Kamchatka Peninsula in Russia, throughout the Aleutian Islands and southwest Alaska, the Pacific coast of British Columbia and southeast Alaska, and south along the west coast of the U.S. to northern Mexico. Rainbow Trout were originally found inland in the western U.S. occasionally as far east as the Rocky Mountains, west of the continental divide and downstream of waterfalls and other natural barriers. Since 1875, Rainbow Trout have been widely introduced throughout the U.S. and the world.

Some of the earliest Rainbow Trout propagation and stocking in Virginia may have occurred at the Montebello Fish Hatchery in Nelson County in the 1920s. U.S. Fish and Wildlife Service records indicate that Rainbow Trout were released into Shenandoah National Park as early as 1943.

There are currently 163 streams (~700 miles) harboring wild Rainbow Trout populations in Virginia (Figure 4). In some of these streams they coexist with native Brook Trout or wild Brown Trout. There are also streams harboring wild Rainbow Trout populations where there is no historical evidence that Brook Trout ever existed.

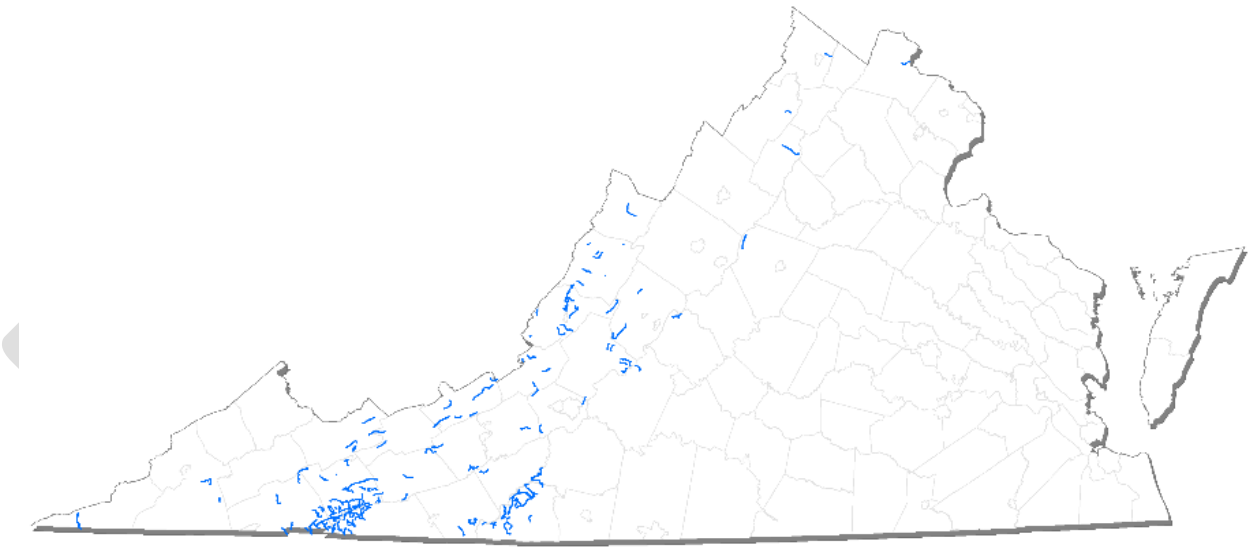

Figure 4. 2018 distribution of wild Rainbow Trout in the Commonwealth of Virginia.

Rainbow Trout prefer well-oxygenated, high quality water less than 70 ˚F. In Virginia wild Rainbow Trout populations are found in freestone streams, spring creeks, and in coldwater tailwaters downstream of large reservoirs. Rainbow Trout eat a wide variety of prey, including insects, crustaceans, mollusks, and small fish. The primary food supply depends on habitat and availability of a particular prey within the habitat.

In Virginia wild Rainbow Trout spawn in the months of February and March. Most wild rainbow trout in the Commonwealth do not grow beyond 12 inches, but larger individuals have been observed in the more productive spring creeks and coldwater tailwaters.

Brown Trout (*Salmo trutta*)

Brown Trout first arrived in the U.S. in 1883 as eggs from Germany. These eggs were distributed to three hatcheries in the U.S.: Cold Harbor Hatchery on Long Island, NY, the Caledonia Fish Hatchery in western NY, and the U.S. Fish Commission hatchery in Northville, MI. Over the following years, these initial stocks were reinforced with the importation of more eggs from Western Europe. Brown Trout were officially first stocked in Virginia's waters in 1961 by the Virginia Game Commission (now VDGIF). These fish were obtained from the U.S. Fish & Wildlife Service White Sulphur Springs Fish Hatchery, and were stocked into the Roanoke River and Smith River below Philpott Dam. VDGIF continues to stock hatchery-reared brown trout in streams and reservoirs across western Virginia.

There are currently 92 streams (~600 miles) containing wild Brown Trout in the Commonwealth (Figure 5). Brown Trout prefer larger, lower-gradient streams and can tolerate warmer water temperatures than Brook or Rainbow Trout. Three of the most significant wild Brown Trout populations in Virginia are located in the Smith River Tailwater downstream of Philpot Reservoir, the Jackson River Tailwater below Gathright Dam/Lake Moomaw, and the Pound River below Flannagan Dam.

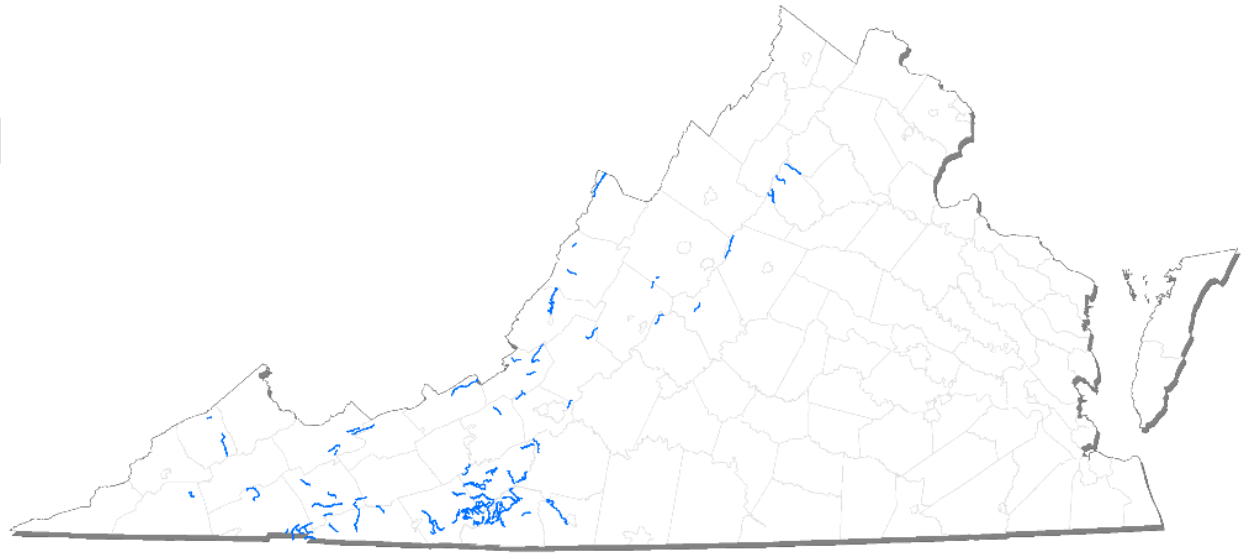

Figure 5. 2018 distribution of wild Brown Trout in the Commonwealth of Virginia.

In Virginia Brown Trout spawn during the months of November and December. Brown Trout feed on aquatic insects, crayfish, and other fish. Brown Trout can attain much larger size than Brook or Rainbow Trout, with individuals >20 inches being documented in many waters across the state.

Wild Trout Anglers

Understanding the number of anglers who fish for wild trout in Virginia is important to effectively manage the resource. A 2016 survey of Virginia Freshwater Fishing License holders revealed that 16.5% of anglers fish for wild trout. Roughly 345,000 fishing licenses are sold annually in Virginia, which would equate to a conservative estimate of 60,000 anglers pursuing wild trout in the Commonwealth. That number has remained consistent for over a decade as extensive angler-creel surveys conducted on Virginia wild trout streams in the early 2000s estimated that 60,000 anglers fished for wild trout (Reeser and Mohn 2004).

VDGIF has surveyed trout license buyers multiple times (1986, 1993, 2001, 2005, 2008, and 2014). In Virginia a separate trout license is only required to fish in designated waters stocked by VDGIF with hatchery trout. While the separate trout license is not required to fish in wild trout waters or stocked trout waters containing wild trout populations June 16 through September 30, 15-20% of trout license holders indicated that they preferred to fish for wild trout (Mohn 2001, 2005, 2008).

Measuring angling pressure, angler demographics, catch and harvest statistics, angler satisfaction, and economic expenditures associated with Virginia's wild trout fisheries is important to effectively manage these resources. On the water angler-creel surveys were conducted on fourteen Virginia wild trout streams in the early 2000s (Palmer 2000; Reeser and Mohn 2004), and two Virginia tailwaters with wild trout fisheries (Bugas 2007; Smith 2008). Selected statistics from these angler-creel surveys are presented in Table 1)

Table 1. Selected statistics from angler-creel surveys conducted on wild trout streams in Virginia.

Angler Statistic	Stream	Citation
Angling Pressure (hours fished/season)		
• 9,315	Whitetop Laurel Creek	(Palmer 2000)
• 120 – 10,215	13 different streams	(Reeser and Mohn 2004)
• 3,435	Jackson River Tailwater	(Bugas 2007)
• 14,886	Smith River Tailwater	(Smith 2008)
Catch Rate (fish caught/hour of angling)		
• 1.02	Whitetop Laurel Creek	
• 0.3 – 3.72	13 different streams	
• 1.48	Jackson River Tailwater	
• 1.66	Smith River Tailwater	

Catch & Release

- 99% Whitetop Laurel Creek
- 99% 13 different streams
- 96% Jackson River Tailwater
- 91% Smith River Tailwater

Angler Satisfaction (% anglers satisfied)

- 85% Whitetop Laurel Creek
- 90% 13 streams

Economics ($ spent / fishing trip)

- $58 Whitetop Laurel Creek
- $34 13 streams
- $40 Jackson River Tailwater
- $24 Smith River Tailwater

In summary, fishing pressure is relatively low on most wild trout streams. However, streams managed with special regulations receive higher angling pressure. Wild trout anglers are generally satisfied with these fisheries, experience excellent catch rates and harvest very few fish. These angler surveys also validate that Virginia's wild trout fisheries are economically important resources.

Wild Trout Management

Virginia Trout Stream Survey (1970s)

Between 1976-79, the Virginia Game Commission (now VDGIF) completed a monumental project identifying the spatial distribution and composition of wild trout populations in Virginia. Virginia's 41 western mountainous counties were surveyed to identify the state's coldwater stream resource and potential. The project intended to identify streams containing wild trout and streams with suitable conditions to develop new wild trout fisheries or hatchery-supported fisheries. The survey crews collected fisheries information, physical characteristics of the streams and drainages, and basic water quality data. This information was used to inventory coldwater streams into a useful stream classification system. Four-hundred and forty-six wild trout streams, which comprised 2028.9 miles, were identified. Approximately 67% of stream miles contained allopatric native Brook Trout (Mohn and Bugas 1980).

Coldwater Stream Classification System

VDGIF's coldwater-stream classification system is based on four criteria: aesthetics, productivity, resident fish community, and stream structure. Each criterion is rated on a scale from "A" through "D" with various combinations resulting in eight classes of coldwater stream.

Class I through IV rate only wild trout habitat (Figure 6) while classes V through VIII rate coldwater habitat not suitable for wild trout, but adequate for year-round holdover of hatchery-reared trout (Appendix I).

Stream Class Descriptions (Wild Trout)

Class I

Stream of outstanding natural beauty possessing wilderness or at least remote characteristics, an abundance of large deep pools, and excellent fish cover. Substrate is variable with abundance of coarse gravel and rubble. Stream contains a good population of wild trout or has the potential for such. Would be considered an exceptional wild trout stream.

Class II

Stream contains a good wild trout population or the potential for one but is lacking in aesthetic quality, productivity, and/or in some structural characteristic. Stream maintains good water quality and temperature, maintains at least a fair summer flow, and adjacent land is not extensively developed. Stream would be considered a good wild trout stream and would represent a major portion of Virginia's wild trout waters.

Class III

Stream which contains a fair population of wild trout with carrying capacity depressed by natural factors or more commonly man-related land use practices. Land use activities may result in heavy siltation of the stream, destruction of banks and fish cover, water quality degradation, increased water temperature, etc. Most streams would be considered to be in the active state of degradation or recovery from degradation. Alteration in land use practices would generally improve carrying capacity of the stream.

Class IV

Stream which contains an adequately reproducing wild trout population, but has severely reduced summer flow characteristics. Fish are trapped in isolated pools where they are highly susceptible to predators and anglers. Such streams could quickly be over-exploited and, therefore, provide difficult management problems.

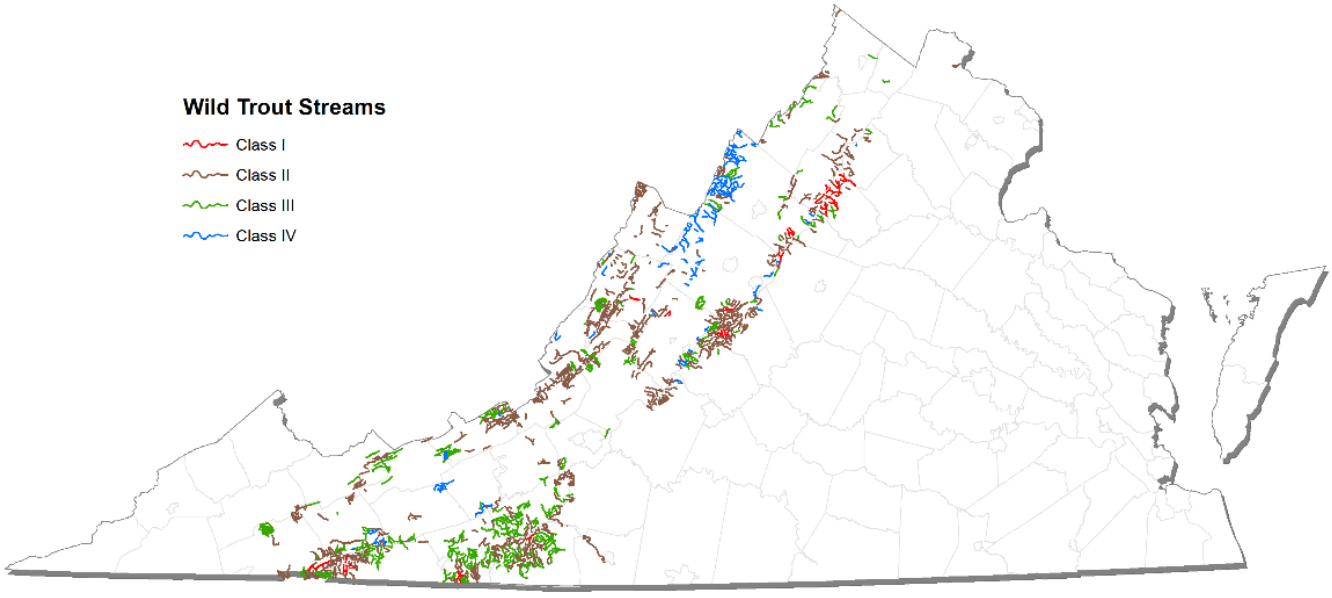

Figure 6. Distribution of Class I-IV wild trout streams (CWSS database 2018).

Coldwater Stream Survey (CWSS) Database

VDGIF maintains a coldwater stream survey database (CWSS) that contains all stream survey data collected by VDGIF for each stream listed. Data collected by the National Park Service from wild trout streams located within Shenandoah National Park are included in the CWSS database. Individual data records include: Stream name, reach code, date information collected, survey location (LAT/LONG), elevation of survey location, fish species collected, number and total length (mm) of each trout sampled, number of non-trout fish individuals (by species) sampled, and select water quality parameters. Permitting agencies like the Virginia Department of Environmental Quality (VDEQ), Virginia Marine Resources Commission (VMRC) and the U.S. Army Corps of Engineers (USACOE) utilize information housed in the CWSS database to make informed regulatory decisions. VDEQ uses the wild trout information found within the CWSS database to designate stream reaches as "Trout Waters" or as one criteria in considering "Exceptional Waters" status, that garners greater protection when issuing water withdraw or wastewater discharge permits. Specific data within the CWSS database is also added to the Virginia Fish and Wildlife Information System (VaFWIS) which can be accessed by the general public through the Department's website: http://vafwis.org/fwis/

Spatial information regarding the location of wild trout streams and the wild trout species present in each stream is taken from the CWSS database and used to create a Geographic Information System (GIS) data layer and interactive mapping application (Wild Trout Streams). This information is available to the public through the agency's website: https://dgif-virginia.maps.arcgis.com/apps/webappviewer/index.html?id=441ed456c8664166bb735b1db6024e48

Wild Trout Stream Monitoring

VDGIF fisheries biologists use electrofishing equipment to monitor the status of each wild trout stream in the CWSS database every 7-10 years. These are qualitative samples conducted in approximately the same location as previous surveys. Newly discovered wild trout populations are classified and added to the database. In order to analyze trends in wild trout populations, Department biologists also monitor select streams on an annual basis. VDGIF currently surveys twenty-eight (28) "sentinel" wild trout streams across western Virginia every summer. Specific wild trout streams are also extensively surveyed to evaluate wild trout population response to various management activities (i. e. regulation changes, habitat manipulations, fish passage projects). Lastly, several of the Commonwealth's best wild trout fisheries are intensively monitored simply to provide accurate up-to-date information to anglers.

Repatriation of Wild Brook Trout Populations

The Department has been quite successful in re-establishing wild Brook Trout populations in multiple streams over the past three decades (Table 2). Successful projects have involved the re-location of wild Brook Trout from one stream to a stream void of wild Brook Trout. Candidate streams were either known to have contained wild Brook Trout populations at one time or were located within the historical range of Brook Trout. Water quality, temperature (Benzing and Fink 2017) and physical habitat were determined to be suitable for Brook Trout prior to the re-location of wild Brook Trout. In many instances, only one re-location (stocking) of wild Brook Trout was necessary before natural reproduction occurred and established a new naturally reproducing population. VDGIF has not been successful at using hatchery-reared Brook Trout to establish self-sustaining wild Brook Trout populations.

Table 2. Streams where VDGIF has been successful in re-locating wild Brook Trout and establishing new self-sustaining wild populations.

Steam	County	Year
Mountain Run	Rockingham	1993
Cabin Mill Run	Augusta	1995
Little Passage Creek	Shenandoah	1997
Mill Run	Shenandoah	2005
Garth Run	Madison	2008
Kinsey Run	Madison	2008
Wildcat Hollow	Fauquier	2008
Little Tumbling Creek	Tazewell	2015

Threats or Concerns to Wild Trout in Virginia (VDGIF Initiatives)

Physical Habitat Degradation

Wild trout require healthy functioning streams with adequate riffle/run/pool habitat. Large woody debris in the stream channel is also very important to wild trout. Wild trout habitat has been degraded where streams have been channelized or "straightened" by human intervention. The ramifications of these activities are misunderstood and often conducted to restore streams damaged by flooding or as a means of reducing future flood damage. During channelization, excavated streambed material is often placed along the stream bank creating "berms" or cobble levees. Channelization leads to streams with shallow water void of complex habitat essential for wild trout. Well-vegetated riparian buffer zones along streams are also vital to supporting wild trout populations. These riparian areas provide large woody debris to the stream channel, stabilize streambank cover, reduce sediment input, and provide shade to help reduce stream temperature. There are stream reaches that currently harbor wild trout, stream reaches downstream of resident wild trout populations, and stream reaches with potential to support wild trout where improvements in physical habitat could benefit wild trout populations.

VDGIF has a stream restoration biologist on staff that restores reaches of wild trout streams that have been degraded due to channelization, poor riparian management, or other land use practices. The Department also supports stream restoration projects on wild trout streams conducted by other government agencies, non-profit organizations and private landowners.

Sedimentation

Wild trout require "pea-sized" gravel substrate free of fine sediments to reproduce. Sediment can also reduce habitat complexity vital for different life stages of wild trout. In addition, sedimentation can also negatively affect stream macroinvertebrate populations, which are a valuable food source for wild trout.

VDGIF supports riparian protection and restoration projects that reduce sedimentation in wild trout streams. Examples include: Erosion and sediment control plans and permits, streambank protection projects, exclusion of livestock from riparian areas, tree planting in riparian zones, construction of raingardens, and stormwater retention structures. The Department developed Time of Year Restrictions (TOYR) when working in wild trout streams to reduce sediment input to the stream when trout are engaged in spawning activity or eggs and sac fry are present. The USACOE includes these TOYR as a regional condition when issuing nationwide permits, and the Virginia Department of Transportation has a memorandum of agreement with VDGIF to follow TOYR guidelines when working in or near wild trout waters.

Time of Year Restrictions (TOYR) for working in wild trout streams:

Brook and Brown Trout Waters	(October 1 through March 31)
Rainbow Trout Waters	(March 15 through May 15)

Fish Passage Barriers

Wild trout require unimpeded mobility up and downstream and access to tributaries for spawning, locating low-flow and thermal refugia, and for maintaining genetic viability. Examples of barriers to wild trout movement in Virginia streams include: dams, poorly-designed box and pipe culverts, and low-water hardened fords. VDGIF has been supportive of efforts that identify barriers on wild trout streams and the removal of these obstructions.

Genetic Integrity of Brook Trout

Beginning as early as the late 1800s, hatchery-reared Brook Trout originating from various wild stocks were stocked throughout the Eastern United States. Using genetic "typing" techniques in the 1970s, scientists determined that some Brook Trout populations in the Southern Appalachian Mountains were genetically distinct (Stoneking et al. 1981). Recently, fish geneticists have been using microsatellite nuclear DNA markers to discover smaller-scale genetic variation between wild Brook Trout populations throughout their native range (King et al. 2012). Though minimal, researchers have documented the transfer of hatchery Brook Trout genes to wild Brook Trout populations (Humston et al. 2012; White et al. 2018). Hence, some fish geneticists are becoming increasingly concerned about protecting the genetic integrity of wild Brook Trout populations.

In addressing genetic integrity of wild Brook Trout populations in Virginia, VDGIF currently employs several strategies. Sterile (triploid) Brook Trout are stocked in watersheds containing Southern Appalachian Strain Brook Trout populations and in watersheds with headwaters originating within the Shenandoah National Park. VDGIF strives to stock sterile Brook Trout in all other watersheds harboring wild Brook Trout populations. However, this is dependent upon the amount of sterile Brook Trout produced in the Department's coldwater hatchery system. In addition, to minimize the risk of hatchery-reared Brook Trout from reproducing with wild Brook Trout, Designated Stocked Trout Waters containing wild Brook Trout populations are not stocked in the fall months. As VDGIF biologists learn more about the genetic distinctness of wild Brook Trout populations, new management approaches may be considered in the future.

Stream Acidification

Scientists first began to document the decline of some wild trout populations in Virginia as a result of acidic deposition in the 1980s. Streams affected in western Virginia are directly down-wind of fossil fuel burning power plants in the Ohio Valley and exhibit underlying geology having extremely poor acid neutralizing capacity. In order to measure the extent of stream acidification, VDGIF helped sponsor the Virginia Trout Stream Sensitivity Study (VTSSS) where intensive water chemistry monitoring in wild trout streams was initiated in 1987.

The VTSSS was an extension of the Shenandoah Watershed Study (SWAS) where stream chemistry monitoring began in 1979 within Shenandoah National Park. SWAS-VTSSS is administered by the Department of Environmental Sciences at the University of Virginia and currently water chemistry parameters are measured in 70+ streams across western Virginia. The SWAS-VTSSS program houses a Mountain Stream Database, which contains water chemistry data for 461 streams from 34 counties across western Virginia (http://people.virginia.edu/~alr8m/POST/scripts/overview.php).

In conjunction with water quality monitoring, twelve VTSSS streams were selected in the late 1980s to have their fish populations monitored biannually. Streams were categorized as sensitive, moderately sensitive, or not sensitive to acidic deposition based on their acid neutralizing capacity. An equal number of streams (4) from each category were selected from locations throughout Northwest and Southwest Virginia. There is an upstream and downstream sampling station on each stream and VDGIF biologists conduct a quantitative electrofishing survey biannually at each survey station.

Reduced emissions of sulphur and nitrogen compounds as a result of the federal 1990 Clean Air Act has led to decreased acidification of some streams in western Virginia. However, the acid neutralizing ability of many streams may be permanently depleted.

Liming of Streams Mitigated for Acidification

In an attempt to mitigate stream acidification and restore wild Brook Trout populations, collaborative research between the Chemistry Department at James Madison University (JMU), U.S. Forest Service and VDGIF was initiated in the late 1980s. Directly depositing limestone sand in the stream channel has been successful at improving water chemistry and benefiting wild Brook Trout in several Virginia streams affected by acidic deposition (Downey et al. 1994; Hudy et al. 2000). Periodic stream liming is currently conducted on several wild Brook Trout streams (Table 3). Routine fish surveys are conducted by VDGIF and water chemistry is analyzed by JMU at several of the limed streams to help determine when additional liming is required.

Table 3. Wild trout streams where limestone sand has been applied to mitigate for acidification.

Stream	County	Year First Limed
Little Stony Creek	Shenandoah	1989
Mill Creek	Shenandoah	1990
Cedar Creek *	Shenandoah	1990
Mountain Run	Rockingham	1993
Laurel Run	Shenandoah	1993
Little Passage Creek	Shenandoah	1997
St. Mary's River & 6 tributaries	Augusta	1999

Burns Creek *	Wise	2001
Pitt Spring Run	Page	2011
Little Tumbling Creek	Tazewell	2014

*no longer limed

Climate Change (stream warming)

Many scientists predict that stream temperatures will increase in the future due to global warming, severely reducing or extirpating wild Brook Trout in the eastern United States. (Clark et al. 2001; Flebbe et al. 2006). It is also predicted that climate change will cause dramatic changes in precipitation patterns, which could be detrimental to wild trout populations. Many of these predictions are based on direct relationships between air and water temperature. One vulnerability assessment conducted for Brook Trout in Virginia predicted that the species could vanish from most of the state by 2050 (Figure 7) However, modelling specific watershed metrics researchers (Trumbo et al. 2014) classified several wild Brook Trout populations in Virginia as being low in sensitivity and vulnerability to climate change (Figure 8). This information will be useful in targeting habitat restoration efforts.

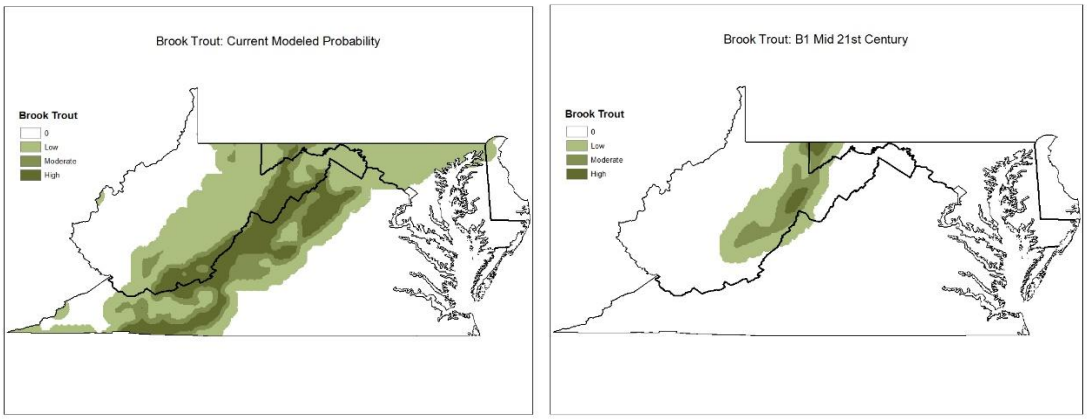

Figure 7. Assessment of Brook Trout vulnerability to climate change (Kane et al. 2013).

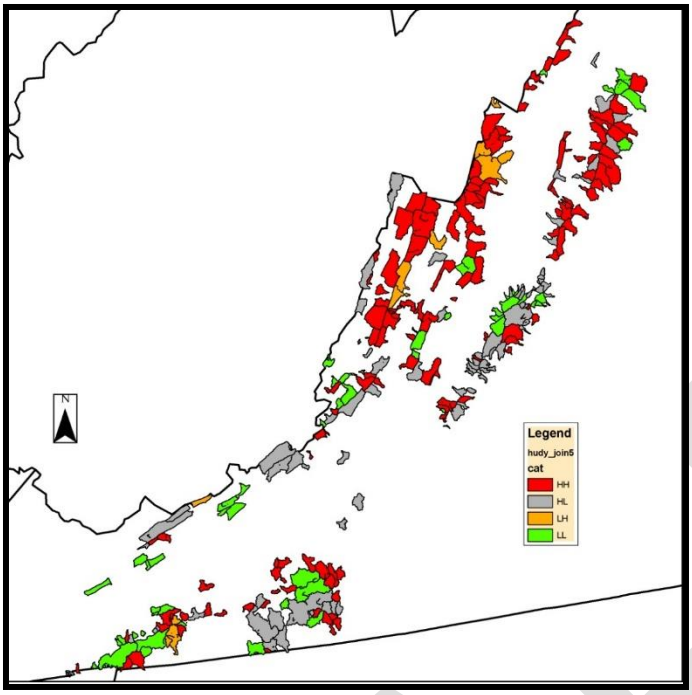

Figure 8. Predicted exposure-sensitivity categories for Brook Trout populations in Virginia (Trumbo et al. 2014)

To measure long-term trends in water temperature of wild trout streams, VDGIF deployed temperature sensing data loggers in 50+ wild trout streams beginning in 2011. These temperature loggers measure water temperature every hour and collect data 12 months of the year. Streams surveyed were purposely selected from different physiographic regions, latitudes, elevations, and with different amounts of groundwater inputs. Specific streams were also selected for monitoring if long-term water chemistry or fish population data were available for those waters. The U.S. Forest Service, National Park Service, United States Geological Survey, and Trout Unlimited are also collecting water temperature data from select wild trout streams in the George Washington and Jefferson National Forest, Shenandoah National Park and private lands.

Interspecific competition between wild Brook Trout and non-native wild Rainbow or wild Brown Trout

It is well documented that non-native wild Rainbow and Brown Trout can negatively impact native Brook Trout at the individual fish level and population level (Waters 1983; Larson and Moore 1985; McKenna et al. 2013). While wild Rainbow Trout have greatly displaced wild Brook Trout in North Carolina and Tennessee and wild Brown Trout have outcompeted wild Brook Trout in New York and Pennsylvania, similar scenarios have not been that severe across Virginia. However, wild Rainbow Trout do outnumber wild Brook Trout in many streams where they coexist in some southwest Virginia watersheds. In many Virginia streams, wild Rainbow and Brown trout appear to cohabit well with wild Brook Trout. There are currently ~185 streams in Virginia that harbor mixed populations of wild Brook, Rainbow and Brown Trout (Figure 9).

In many areas of Virginia, wild Rainbow and Brown Trout occupy habitats less suitable for Brook Trout. These areas are often in lower downstream reaches of wild Brook Trout streams. Wild Rainbow and Brown Trout also occupy coldwater streams where there is no historical evidence of Brook Trout habitation or in artificially created cold tailwaters downstream of large reservoirs (i. e. Jackson and Smith River).

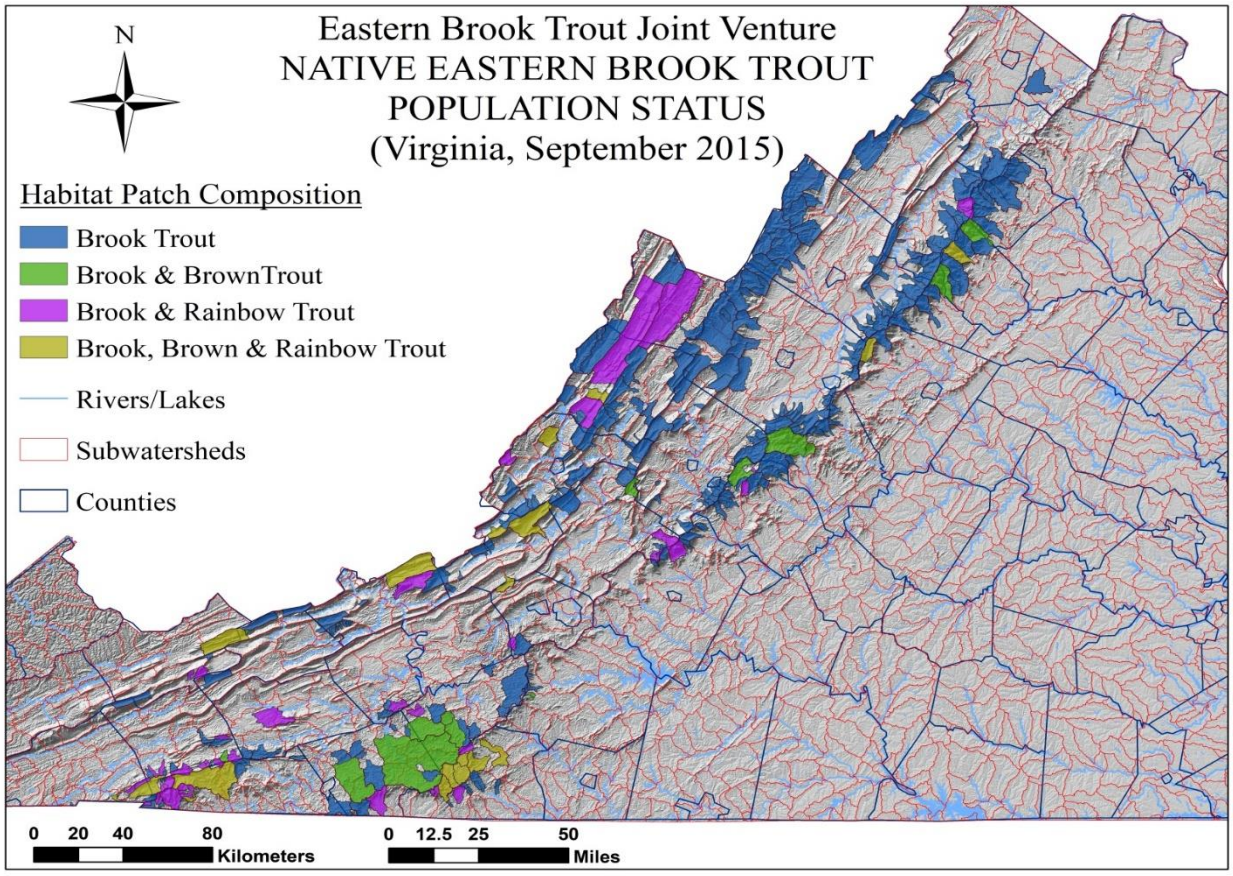

Figure 9. Distribution of mixed populations of wild trout in Virginia (EBTJV 2016)

VDGIF has taken various actions to minimize the potential of non-native Rainbow or Brown trout from becoming naturalized in watersheds inhabited by allopatric wild Brook Trout populations. Beginning in the 1980s after the completion of the Virginia Trout Stream Survey, stocking of hatchery-reared trout was discontinued in many streams containing allopatric wild Brook Trout populations. Starting in the mid-2000s, where the Department was stocking hatchery-reared Rainbow and Brown Trout in watersheds inhabited by allopatric wild Brook Trout populations, a transition was made to using sterile (triploid) Rainbow and Brown Trout. This would also include stream reaches and impoundments in the Department's stocked trout program located immediately downstream of wild Brook Trout populations.

Code of Virginia - 4 VAC 15-320-60 declares that it is unlawful to release any species of fish into inland waters of the Commonwealth without written approval from VDGIF (privately-owned ponds and lakes are exempt). This Stocking Authorization allows VDGIF to regulate

which trout species can be stocked in streams by the public. To prevent the naturalization of non-native trout, VDGIF biologists will not approve a stocking authorization for Rainbow or Brown trout in streams containing or directly downstream of pure wild Brook Trout populations.

Interspecific competition between wild Brook Trout and hatchery-reared trout.

Negative impacts of stocking hatchery-reared trout on wild Rainbow and wild Brown Trout have been well documented (Hearn 1987; Vincent 1987; Carline et al. 1991). However, the interactions and negative effects of hatchery-reared trout on wild Brook Trout are not as definitive. Fisheries managers in New York documented declines in wild Brook Trout populations from intensive stocking of hatchery-reared Brown Trout (McKenna et al. 2013). In contrast, LaRoche (1979) observed no differences in wild Brook Trout populations in stocked and un-stocked reaches of two central Virginia streams.

To minimize potential negative impacts to wild Brook Trout populations from hatchery-reared trout the Department has taken various management actions. Beginning in the 1980s after the completion of the Virginia Trout Stream Survey stocking of hatchery-reared trout was discontinued in many streams containing healthy wild trout populations. In streams containing wild Brook Trout populations that remain in the hatchery-stocking program, trout are not stocked during the spawning season (Oct-Dec). These streams are designated "No Stocking Fall" (NSF) on the Department's list of Designated Stocked Trout Waters.

Code of Virginia - 4 VAC 15-320-60 declares that is unlawful to release any species of fish into inland waters of the Commonwealth without written approval from VDGIF (privately-owned ponds and lakes are exempt). This Stocking Authorization allows VDGIF to regulate where hatchery-reared trout can be stocked in streams by the public. VDGIF biologists use discretion in approving private trout stocking in streams containing pure wild Brook Trout populations. The number and species of hatchery trout stocked can be manipulated to minimize potential impacts to wild Brook Trout.

Invasive Aquatic Species

The introduction of invasive aquatic species could threaten wild trout populations. *Didymosphenia geminate* (Didymo) is an invasive algae that began to proliferate in the Jackson River Tailwater, Smith River Tailwater, and Pound River Tailwater in the mid- 2000s. While Didymo has not been shown to negatively impact wild trout populations in waters outside of Virginia (Sherarer 2007; SACD 2007; James and Chipps 2010), scientists conclude that more research is needed. VDGIF fisheries biologists have not been able to document any negative impacts to wild trout populations in the Commonwealth. Presently, Didymo represents more of a nuisance to Virginia anglers than a threat to wild trout populations. However, VDGIF collaborated with the U.S. Forest Service, VDCR, and TU on an education campaign designed to prevent the spread of Didymo to additional waters (Figure 10). The Department also provides information regarding Didymo on the agency website www.dgif.virginia.gov/didymo and is supportive of national programs like "Stop Aquatic Hitchhikers"

http://stopaquatichitchhikers.org/ that educate the public about the dangers of transporting invasive aquatic organisms.

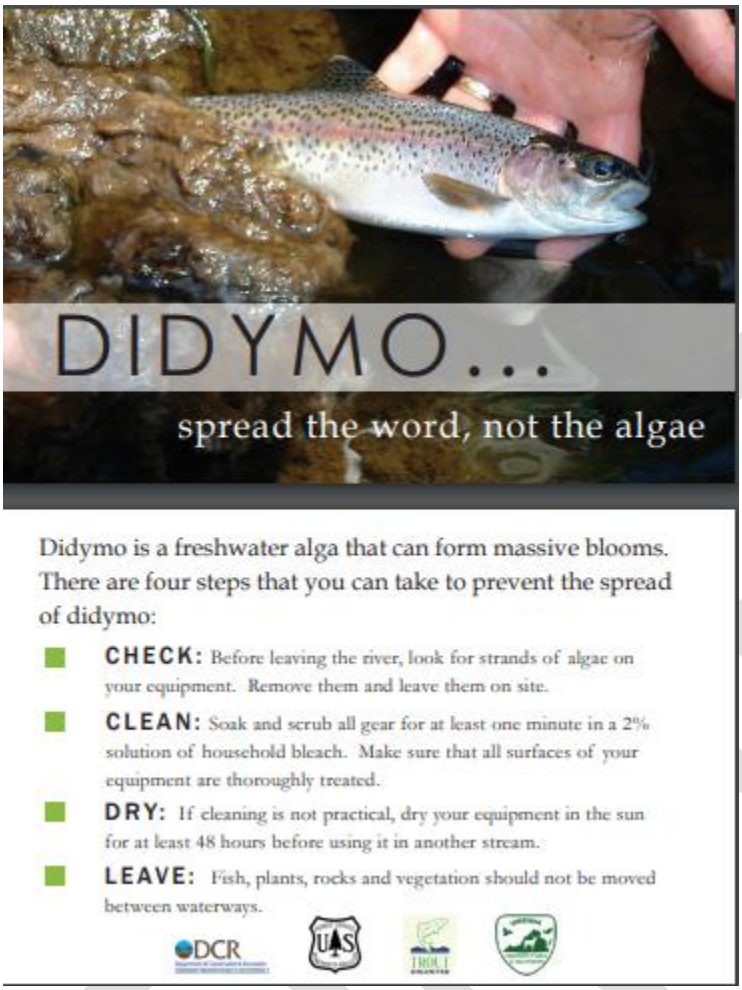

Figure 10. Didymo education and outreach information used by VDGIF

Fish Pathogens

There is a risk of exposing wild trout populations to exotic or unique fish pathogens from stocking hatchery-reared trout or transporting wild fish of any species from another water body. To minimize this risk, VDGIF has recently taken important steps to reduce disease outbreaks and improve trout health in the Department's trout hatchery system. The Department is currently working to receive American Fisheries Society disease/pathogen management certification for each of the five agency coldwater hatcheries or fish culture stations (Marion, Wytheville, Paint Bank, Montebello, Coursey Springs). The Department has also implemented a biosecurity plan for each of its fish culture facilities and entire hatchery system. In addition, the Department has a policy where trout from Department coldwater hatcheries showing clinical signs of disease are not to be released (stocked) into the wild.

VDGIF does not have any regulatory authority over private fish culture operations in Virginia. The Virginia Department of Agriculture and Consumer Services (VDACS) is the state agency that regulates private aquaculture in the Commonwealth.

Code of Virginia - 4 VAC 15-320-60 declares that is unlawful to release any species of fish into inland waters of the Commonwealth without written approval from VDGIF (privately-owned ponds and lakes are exempt). This Stocking Authorization allows VDGIF to regulate which trout species can be stocked in streams by the public and must approve of the source (private hatchery) of these trout. VDGIF biologists have the ability to deny a stocking authorization if the source hatchery was known to contain pathogens threatening fish in the wild.

Angling Mortality (perceived threat)

Anglers are often concerned that special regulations like catch and release only or lure type regulations are necessary to protect or enhance wild trout populations. Environmental conditions (floods and droughts) have the greatest influence in determining the abundance of fish in wild trout populations across Virginia. Physical habitat and water quality are other factors that also determine trout abundance and growth in wild trout streams.

Annual natural mortality for adult wild trout in Virginia can be as high as 60% (Mohn and Bugas 1980). For this reason, angler induced mortality or harvest would need to be very high in order for the public to observe changes in adult trout numbers attributed to angling. A six fish per day creel limit (all trout species combined) is in place to protect wild trout populations from over-harvest. However, angler-creel surveys on Virginia wild trout streams indicate that >90% of trout caught are released (Palmer 2000; Reeser and Mohn 2004; Bugas 2007). Spawning success or recruitment is what determines the abundance of adult fish in a wild trout population. To protect wild trout until they reach sexual maturity (breeding age or size), VDGIF imposes a statewide 7-inch minimum-size regulation for wild trout (Brook, Rainbow, Brown). Different minimum-size or "slot-limit" regulations have also been used on some wild trout streams in an attempt to increase the abundance of larger trout. One example would be the Smith River Tailwater downstream of Philpot Reservoir.

Bait and/or hook-type restriction regulations have also been imposed on some Virginia wild trout fisheries. While there have been no research studies investigating the impacts of these specific regulations on wild trout populations in Virginia, multiple studies have shown that angling mortality rates for wild trout using a wide range of bait and hook types were not high enough to have noticeable effects at a population level (DuBois and Kuklinski 2004; Kazyak et al. 2016). One study in Pennsylvania reported that a catch and release regulation failed to increase overall abundance or abundance of preferred size wild Brook Trout in several high-quality wild trout streams (Detar et al. 2014).

Most wild trout populations in Virginia are highly influenced by environmental conditions (Kanno et al. 2016). However, some, particularly tailwater fisheries with artificial flow and temperature regimes, special regulations may be beneficial in maintaining more quality size fish in the population.

Issues / Goals / Objectives / Strategies

Issue 1: Determining status of wild trout stocks (Spatial Distribution & Population Dynamics)

Goal 1: Determine spatial distribution of wild trout. Resolution: miles of streams or presence/absence in catchments

Objective: Monitor changes to the spatial distribution of wild trout

Strategy 1: Conduct fish surveys on each wild trout stream in the VDGIF Coldwater Stream Database every 5 to 7 years (use best available technology)

Strategy 2: Update DGIF Coldwater Stream database continuously

Strategy 3: Update wild trout distribution GIS mapping application continuously

Strategy 4: Identify newly discovered wild trout streams

Strategy 5: Periodic spatial distribution reporting and communication with partners

Strategy 6: Incorporate citizen science results

Goal 2: Determine population status of wild trout resources and ranking system for resiliency/seasonal occupancy model

Objective: Update the population status of each individual wild trout stream every 7 years

Strategy 1: Conduct standardized population assessments (quantitative)

Strategy 2: Develop recruitment and size structure index

Strategy 3: Evaluate emerging technologies to evaluate genetic integrity of Brook Trout populations

Strategy 4: Administer/maintain VDGIF coldwater stream classification system

Strategy 5: Periodic population reporting and communication with partners

Strategy 6: Develop metrics to determine resiliency for future ranking (at risk populations)

Issue 2: Introduction of non-native aquatic species

Goal 1: Protect wild trout populations from introduced aquatic species

Objective: Create a strategy to prevent the introduction of non-native aquatic species (all aquatic organisms)

Strategy 1: Support regulations, programs, or policies intended to minimize the risk of introducing known non-native aquatic species to waters containing wild trout

Strategy 2: Create a protocol to deal with introduced species (case by case)

Strategy 3: Create a database to keep up with introduced species

Strategy 4: Educate the public regarding the potential impacts of non-native species on wild trout

Goal 2: Protect allopatric Brook Trout populations from wild non-native trout

Objective: Maintain the current number of allopatric Brook Trout Populations through 2028.

Strategy 1: Utilize sterile (triploid) hatchery trout in VDGIF Designated Stocked Trout Waters within watersheds containing allopatric populations of wild Brook Trout

Strategy 2: Maintain/improve/enforce fish stocking authorization for private landowners

Strategy 3: Educate the public regarding the potential impacts that non-native trout can impose on allopatric Brook Trout populations

Strategy 4: Support research on impacts of non-native trout to allopatric Brook Trout populations

Strategy 5: Apply new advancements in science or technology to maintain allopatric Brook Trout populations

Strategy 6: Preserve barriers (dams and culverts) that continue to protect allopatric Brook Trout populations

Goal 3: Protect sensitive native-aquatic species from wild non-native trout (primarily Brown Trout)

Objective: Minimize potential for non-native trout to become established in waters known to have native aquatic species sensitive to non-native trout

Strategy 1: Evaluate risks to native aquatic species when managing non-native trout

Strategy 2: Utilize sterile (triploid) hatchery trout

Strategy 3: Consider trophic guild impacts (choice of species stocked)

Strategy 4: Maintain/improve/enforce fish stocking authorization permits for private landowners

Issue 3: Habitat Quality and Quantity

Goal 1: Protect physical habitat, water quality, and water quantity in wild trout waters

Objective: Protect high quality habitat conditions in 25 trout streams by 2028.

Strategy 1: Identify wild trout watersheds that lack land protection

Strategy 2: Prioritize wild trout populations in greatest need of protection

Strategy 3: Work with partners, land managers, landowners, and the public in using available tools or existing programs to protect or enhance wild trout habitat.

Strategy 4: Support land acquisition or conservation easements in wild trout watersheds

Strategy 5: Develop exceptional waters designation

Strategy 6: Develop a protocol to assess habitat

Strategy 7: Support flow/chemical regimes that enhances habitat in tailwaters

Goal 2: Enhance degraded or marginal habitat

Objective: Improve/protect habitat conditions in 25 wild trout reaches across Virginia by 2028.

Strategy 1: Along with partners, identify vulnerable or degraded reaches of streams harboring wild trout.

Strategy 2: Support riparian restoration in wild trout watersheds

Strategy 3: Support In-stream habitat improvement in wild trout watersheds

Strategy 4: Support programs and best management practices (BMPs) that improve water quality and quantity

Strategy 5: Work with partners, land managers, landowners, and the public in using available tools or existing programs to protect or enhance wild trout habitat.

Strategy 6: Periodic habitat reporting and communication with partners

Issue 4: Brook Trout Genetics

Goal 1: Integrate Brook Trout genetic composition needs using best available science

Objective: Assimilate and analyze all existing genetic data collected from wild Brook Trout populations in Virginia

Strategy 1: Identify data gaps regarding Brook Trout genetics

Strategy 2: Utilize genetic knowledge to direct Brook Trout management

Strategy 3: Evaluate genetics in hatchery system

Issue 5: Expand the spatial distribution of wild trout

Goal 1: Repatriate Brook Trout to streams where they have been extirpated or in new/ suitable waters within historic range

Objective: Re-introduce or establish Brook Trout to 5 populations by 2028.

Strategy 1: Utilize available tools and data to identify waters with high potential for successful re-establishment with management and restoration

Strategy 2: Utilize available tools and data to identify water with current conditions for successful re-establishment

Strategy 3: Refine protocol for re-locating wild Brook Trout for the purpose of establishing a population.

Strategy 4: Barrier removal

Goal 2: If habitat/conditions are unsuitable for Brook Trout or outside of historic range, examine other trout species options

Objective: Establish new wild Rainbow or Brown Trout populations in 5 streams by 2028.

Strategy 1: Identify appropriate streams (streams outside of historic range or attempts to establish Brook Trout have been unsuccessful)

Strategy 2: Periodic reporting and communication with partners with emphasis on attempts to establish Brook Trout

Issue 6: Angling for wild trout

Goal 1: Enhance angler access to wild trout fisheries

Objective: No net loss of public angler access to wild trout fisheries and increase angler access to 5 wild trout fisheries by 2028

Strategy 1: Work with partners/private landowners to gain access to wild trout fisheries

Strategy 2: Improve infrastructure as needed (parking lots, fence crossings, trails etc.) new or expanded

Strategy 3: Develop an outreach strategy with private landowners or agencies

Goal 2: Maintain wild trout populations in coldwater tailwaters

Objective: Maintain or improve the current wild trout fisheries in the Jackson River, Smith River, Dan River and Pound River coldwater tailwaters

Strategy 1: Coordinate with dam operators to maintain optimum release flows, chemistry, and temperatures that maximize trout habitat

Goal 3: Utilize fishing regulations to meet biological or social objectives for wild trout fisheries

Objective: Evaluate wild trout fishing regulations and adjust as needed

Strategy 1: Maintain suitable minimum-size regulation and daily creel limits for wild trout (all 3 species)

Strategy 2: Evaluate current special regulations imposed on specific wild trout fisheries as identified in the Code of Virginia (Virginia Administrative Code; Title 4. Conservation and Natural Resources; VAC Agency No. 15. Department of Game and Inland Fisheries)

Issue 7: Stocking hatchery trout in wild Brook Trout waters (direct competition/establishment non-native trout, introduction of pathogens)

Goal 1: Minimize the potential negative impacts of hatchery trout on wild Brook Trout populations

Objective: Use best available science when stocking hatchery trout into wild Brook Trout waters

Strategy 1: Evaluate the social economics of current DGIF hatchery trout stockings in streams containing wild Brook Trout populations and remove if possible

Strategy 2: No new stream reaches that contain wild Brook Trout populations will be added to the Department's list of Designated Stocked Trout Waters

Strategy 3: Continue "No Fall Stocking" in streams harboring wild brook trout populations that are also VDGIF Designated Stocked Trout Waters

Strategy 4: Continue to stock only Brook Trout in VDGIF Designated Stocked Trout Waters containing wild Brook Trout populations

Strategy 5: Utilize sterile Brook Trout when stocking in watersheds harboring wild Brook Trout populations identified as having distinct genetic profiles

Strategy 5: Maintain/improve/enforce fish stocking authorization permits for private landowners

Strategy 6: Support research on impacts of hatchery trout to Brook Trout populations

Issue 8: Connectivity

Goal 1: Identify fish passage barriers affecting wild trout populations

Objective: Identify 50 fish passage barriers on wild trout streams by 2022

Strategy 1: Work with partners to utilize data sources that have identified fish passage barriers (ex. NAACC, PEC, USFS, TU, VDOT)

Strategy 2: Train staff to assess barriers (NAACC protocol)

Strategy 3: Educate the public and partners regarding aquatic organism passage

Goal 2: Support efforts to remove or modify fish passage barriers on wild trout streams

Objective: Remove 15 fish passage barriers on wild trout streams by 2028 as funding allows, wild Brook Trout populations top priority by 2022.

Strategy 1: Evaluate pros-and-cons of establishment vs. removal of barriers (non-native trout) on a case by case basis

Strategy 2: Collaborate with VDOT and USACOE to incorporate re-designed culvert replacements in their strategic planning efforts

Strategy 3: Monitor success of fish passage projects

Strategy 4: Work with partners to identify and leverage funding for fish passage projects

Strategy 5: Prioritize projects, allopatric Brook Trout populations top priority

Issue 9: Fish health

Goal 1: Determine the health status of wild trout populations (spatial occurrence of pathogens)

Objective: Complete fish health evaluation on 50 wild trout populations by 2028

Strategy 1: Participate in the USFWS Wild Fish Health Survey (disease testing of wild trout populations)

Strategy 2: Review historical wild trout health data (Shenandoah National Park)

Strategy 3: Share findings with partners and public

Goal 2: Protect wild trout populations from exposure to introduced pathogens

Objective: Reduce the risk of introducing pathogens via fish importation or hatchery practices

Strategy 1: Coordinate with other states, Virginia Department of Agriculture and Consumer Services (VDACS) and private aquaculture to implement fish health guidelines for the importation of fish into Virginia

Strategy 2: Coordinate with Virginia Department of Agriculture and Consumer Services (VDACS) and private aquaculture to implement fish health guidelines for the transfer of fish within Virginia

Strategy 3: Achieve American Fisheries Society Blue Book Health certification for each VDGIF coldwater fish hatchery or fish culture station

Strategy 4: Educate the general public regarding the threat to wild trout populations from fish pathogens transmitted by cultured fish

Strategy 5: Maintain/improve/enforce fish stocking authorization permits for private landowners

Strategy 6: Examine more rigorous in-house best management practices (BMPs) to prevent spread

Issue 10: Marketing, Outreach, Education

Goal 1: Increase public awareness of wild trout and angling for wild trout

Objective: Increase the number of anglers fishing/concerned for wild trout in Virginia

Strategy 1: Determine number and economic impact of wild trout anglers

Strategy 2: Develop a marketing plan for Virginia's wild trout resources (including social media)

Strategy 3: Support VDGIF's R3 program (Recruitment- Retention-Reactivation) for wild trout angling

Strategy 4: Maintain the Department's GIS online mapping application of wild trout streams annually

Strategy 5: Support partners' outreach programs that support wild trout

Strategy 6: Develop a detailed and comprehensive "Virginia Trout Fishing Guide"

Strategy 7: Support Trout in The Classroom and other programs (U.S. Forest Service youth snorkeling program)

Strategy 8: Develop wild trout viewing appreciation

Strategy 9: Merge citizen science and agency science

Issue 11: Long-term financial support for wild trout resources

Goal 1: Seek alternative funding sources with dedicated account for wild trout management

Objective: Increase VDGIF funding for wild trout resources by 20% by 2028.

Strategy 1: Investigate using non-traditional VDGIF funds

Strategy 2: Create a Conservation Stamp

Strategy 3: Trout fishing license required year-round to fish for stocked trout or wild trout

Strategy 4: Leverage funding from non-traditional sources

Strategy 5: Educate the public on how purchasing a fishing license benefits wildlife conservation

Strategy 6: Investigate license structure for non-residents

Goal 2: Conduct internal analysis of funding directed toward wild trout management

Objective: Produce bi-annual report detailing funds spent on wild trout management

Strategy 1: Develop a periodic "report card" of VDGIF progress implementing strategies outlined in this plan

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Appendix I. Coldwater stream rating criteria and stream classification matrix

Aesthetics – This term may be somewhat misleading since it generally refers to a subjective evaluation of beauty. However, in this case it is used to describe the degree of human activity adjacent to the stream which has the potential to cause environmentally damaging impacts to the stream ecosystem.

Rating "A"

Surrounding land is not developed and is generally of wilderness characteristic. Stream may be accessible by vehicular trail, but the road/trail must blend naturally, must not be eroding, and must be very lightly traveled. Evidence of human abuse should be minimal. Water must be clear and clean, siltation minor, and streambanks stable and well protected.

Rating "B"

Surrounding land is only lightly developed with possibly a road, light residential development, or light to moderate agricultural use. Bank cover remains in natural state and water is usually clear and clean with only minor siltation.

Rating "C"

Stream itself remains in natural state, but adjacent land is further developed. Land use may include a significant number of residential units, some industrial development, or widespread agricultural use or logging operations. Stream banks remain well protected although not necessarily in their natural state. Water is usually clear and clean with some siltation.

Rating "D"

Bank cover is generally poor with actively eroding banks. Adjacent land development may be extensive or agricultural use excessive. Stream may be channelized. Water is not usually clear, may be polluted, or is turbid after only light rain. Siltation is generally heavy.

Productivity – This term refers to trout productivity rather than total biomass production. Therefore, it takes into account not only food production, but also the habitat requirements of temperature, water quality, and clean substrate.

Rating "A"

Stream contains all of the following characteristics: 1) Trout food organisms abundant ; 2) Water chemistry optimum for trout (pH – 6.5 / D.O. – 6.0ppm / Alkalinity – 30ppm) ; 3) Water temperature within optimum range for trout (maximum temperature < 21°C) ; 4) Contains little evidence of siltation.

Rating "B"

Stream lacks one item in "A", but contains good water chemistry and water temperature characteristics.

Rating “C”

Stream lacks two items in “A”, but contains borderline water chemistry and water temperature within the tolerable range for trout.

Rating “D”

Stream lacks water chemistry and / or water temperature characteristics necessary for trout survival.

Resident Fish Community – Refers primarily to the number of wild trout present, but also takes into account the presence of warmwater fish species.

Rating “A”

Stream contains a good wild trout population or has the potential for such. Trout are abundant (a single electrofishing effort produces at least 4 trout/100 foot of stream), are reproducing adequately, and exhibit good growth rate.

Rating “B”

Stream contains a wild trout population, but population levels are low (a single electrofishing effort produces <4 trout / 100m foot of stream). Trout populations may be depressed due to natural characteristics of the stream and/or man related alterations to the stream.

Rating “C”

Stream does not contain a significant population of wild trout, nor does it have the potential for such, although occasional individuals may be encountered. Stream does not contain a significant population of warmwater fishes and would be suitable for stocking of hatchery trout.

Rating “D”

Stream contains a large population of warmwater species which would compete with trout. Stream would not be suitable for stocking hatchery trout.

Stream Structure – This refers to the physical habitat of the stream. Main factors involved are the stability of summer flow, the amount and quality of pool habitat available, the quality of fish cover provided and substrate composition.

Rating “A”

Stream has good flow with 75-100% of the normal stream channel occupied by summer flow. Pools are abundant (>30%) with good depth and excellent fish cover. Substrate is variable with an abundance of coarse gravel and rubble.

Rating “B”

Stream has fair to good flow with 30-75% of the normal stream channel occupied by summer flow. Pools remain adequately (>20%) with good depth and fish cover. Substrate is variable with an abundance of coarse gravel and rubble.

Rating “C”

Stream has fair to good summer flow, but is noticeably lacking in pool number, size or depth, or in fish cover. Stream may also be lacking or overly dominant in certain substrate types, which would limit habitat diversity, productivity, or spawning.

Rating “D”

Stream has poor flow with 0-30% of the normal stream channel occupied by summer flow. Stream has a few pools and is shallow with little fish cover. Fish are subject to heavy summer predation and offer little recreational value.

Stream Classification Matrix

	Aesthetics	A	A	B	B	C	C	A	B	C	D	D	D	A	B	C	D
	Productivity	A	B	A	B	A	B	C	C	C	A	B	C	D	D	D	D
Fish	Physical																
A	A	1	1	2	2	2	2	2	2	2	3	3	3	NP	NP	NP	NP
A	B	2	2	2	2	2	2	2	2	2	3	3	3	NP	NP	NP	NP
A	C	2	2	2	2	2	2	2	2	2	3	3	3	NP	NP	NP	NP
B	A	2	2	2	3	3	3	3	3	3	3	3	3	NP	NP	NP	NP
B	B	2	2	3	3	3	3	3	3	3	3	3	3	NP	NP	NP	NP
B	C	2	2	3	3	3	3	3	3	3	3	3	3	NP	NP	NP	NP
A	D	4	4	4	4	4	4	4	4	4	4	4	4	NP	NP	NP	NP
B	D	4	4	4	4	4	4	4	4	4	4	4	4	NP	NP	NP	NP
C	A	5	5	5	5	5	5	6	6	6	7	7	7	NA	NA	NA	NA
C	B	5	5	5	6	6	6	6	6	6	7	7	7	NA	NA	NA	NA
C	C	6	6	6	6	6	6	6	6	7	7	7	7	NA	NA	NA	NA
C	D	8	8	8	8	8	8	8	8	8	8	8	8	NA	NA	NA	NA
D	A	NA----------															
D	B	NA----------															
D	C	NA----------															
D	D	NA----------															

NA – not adequate for trout ; NP – not a possible combination

Mohn and Bugas 1980